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Effects of Channel Changes on Juvenile Salmonids and their Habitat in Three Western Washington Locations

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by
Stephen Dilley
Fisheries Management Biologist

INTRODUCTION

Channelization of rivers and streams for flood control, urban development and highway construction has impacted salmonid habitat in many western Washington streams. These activities, coupled with poor logging practices, have been major contributors to a gradual but continued loss in the number of rivers and streams available for salmon and steelhead production. If the State of Washington is to preserve its valuable commercial and sport salmon fishing industry, as well as steelhead trout fishing, it is of paramount importance that habitat managers protect the fresh water environment which is so necessary for good salmonid production. Studies by Cederholm and Koski (1977) and Chapman and Knudson (1980) have addressed particular aspects of these problems in western Washington. Most other studies in the State of Washington which deal with channel modification were conducted on streams east of the Cascade Mountains and may not be applicable because of the higher rainfall and heavily forested river basins west of the Cascades.

Three streams in western Washington (Figure 1) were studied to gain information regarding the effects of streambed channel modification. These locations are the Pilchuck River, Childs Creek and Clear Creek.

Pilchuck River

The Pilchuck River is located in Snohomish County and is a major tributary to the Snohomish River. The main stem Pilchuck serpetines throughout the Pilchuck Valley and offers predominantly moderate gradient with good to excellent pool-riffle balance. The main stem section provides spawning and rearing for chinook, coho, pink, and chum salmon plus steelhead and cutthroat trout. Excellent juvenile salmonid rearing habitat exists in the river, as well as in the accessible tributaries. The Snohomish River basin supports the largest wild coho population in Puget Sound and all salmon stocks in the basin are managed for natural spawning requirements. Salmon production in this system is dependent upon maintenance of existing spawning and rearing habitat.

The Fisheries Assistance Office (FAO) of the U.S. Fish and Wildlife Service became involved in this project in 1979 when Olympia Ecological Services (ES) requested assistance in assessing short and long term effects on salmonid populations resulting from a channel change of .25 miles on the Pilchuck River. In addition, a number of instream fishery enhancement devices were placed in the new channel and ES and the Washington Department of Fisheries (WDF) were very interested in determining their effectiveness as mitigation techniques. If these devices prove effective, they will be used by ES and WDF in future mitigation efforts.

The new channel, constructed parallel to the original old channel from approximately river mile 3.0 to 3.3, was partially opened to running water from the Pilchuck River in June of 1980. On August 18, 1980, the old channel was sealed off completely and the entire river diverted into the new channel.

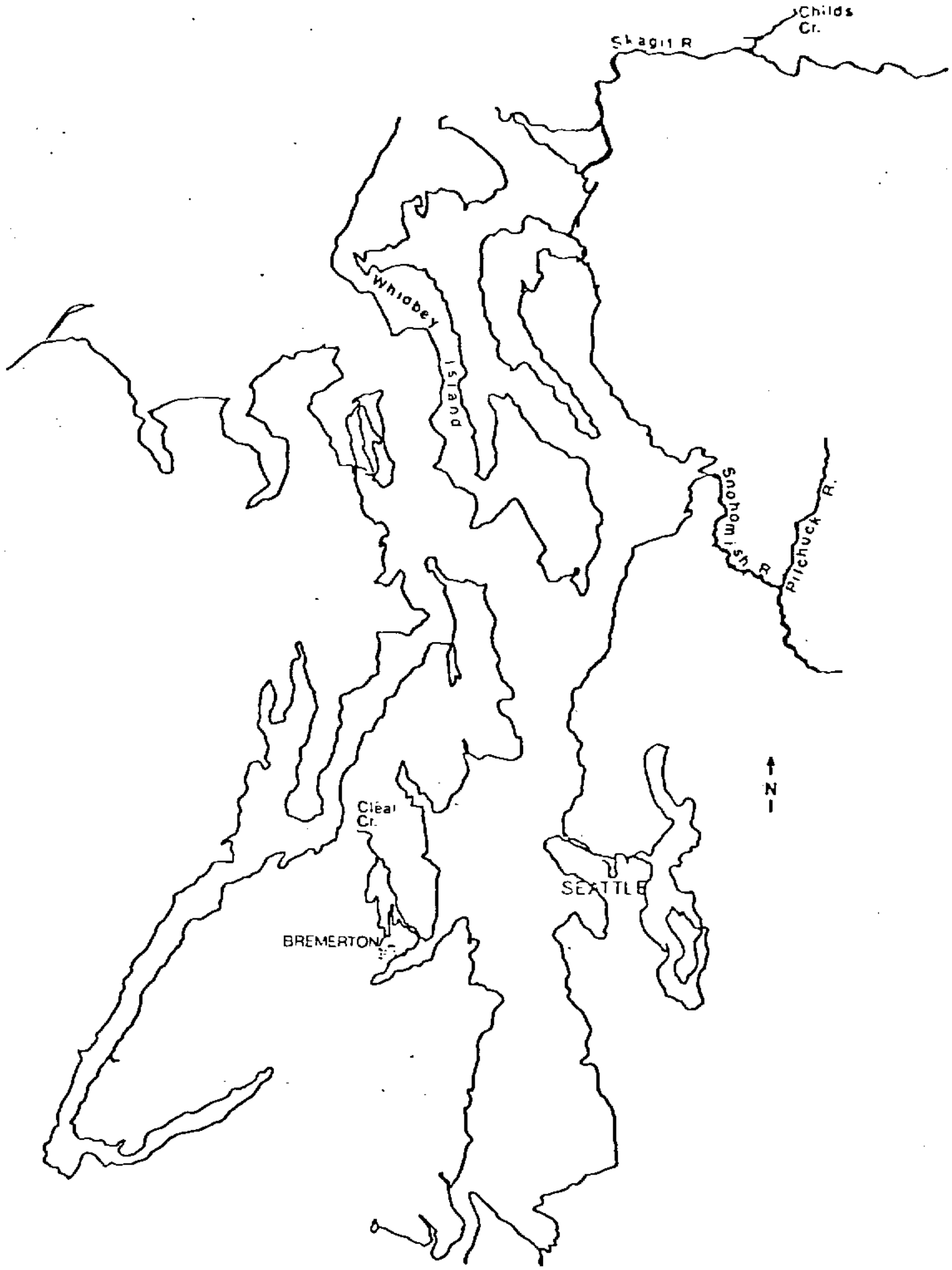

FIGURE 1. Location of the three western Washington study streams used to assess the impacts of channelization on salmonid rearing biomass

Childs Creek

Childs Creek is a tributary to the Skagit River located northeast of Sedro-Wooley. This stream descends from an elevation of about 3,000 feet with falls and cascades of moderately steep gradient. Only the lower two miles are accessible to anadromous salmonids. Coho, chum, steelhead and cutthroat are found in this creek. All salmon stocks in the Skagit Basin are also managed for natural spawning requirements.

Chapman and Knudsen (1980) studied short term effects on salmonid biomass relative to stream alterations on a number of western Washington streams including Childs Creek. A portion of the stream was channelized August, 1978. Sampling began in July, 1978, to gather information pertaining to long term impacts on salmonid production due to channelization.

Clear Creek Watershed

The Clear Creek watershed lies in Kitsap County north of Bremerton and flows south through a broad shallow valley entering Dyes Inlet at its northern most tip near the town of Silverdale. Portions of this watershed are heavily developed with residential homes and small farms. Upper portions of the watershed along with the lower 0.25 miles of Clear Creek have moderate gradients, while the other portions have shallow gradients and sandy substrate. This creek is presently managed for natural chum spawning requirements. Coho, steelhead, and cutthroat are also found throughout all accessible reaches. This streambed will be altered at a future date by the construction of a major highway. FAO began sampling this stream in order to gather baseline data necessary to assess the eventual effects of the project on salmonid habitat.

METHODS

At least two study sections were sampled on each stream. A test section, which is the area to be altered, and an upstream control. Changes in the salmonid population of the test section relative to the control were compared in an attempt to assess impacts of the project. Population estimates were made for each section utilizing a Zippen two pass catch removal population estimate (Zippen, 1958) except on the Pilchuck River which was too large for effective use of the Zippen method. A Peterson mark-recapture population estimate was used on the Pilchuck River.

Zippen estimates were made by collecting fish with a Coffelt backpack shocker. This method requires that a significant portion of the population be removed on the first pass with declining catches occurring on subsequent samplings of the same area. Each section was blocked at both ends with a beach seine to insure that no fish entered or left the section during sampling. Estimates were computed using Zippen's (1958) formula

$$\hat{N} = \frac{C_1^2}{(C_1 - C_2)}$$

Where: $\hat{N}$ = population estimate
C_1 = catch in the first pass
C_2 = catch in the second pass.

Fish were collected on the Pilchuck using a Coffelt pulsator powered by a 115-volt generator and a 60-foot beach seine. These fish were then freeze-brand marked. Each study section was assigned a specific mark indicating section and date captured. Fish were then sampled two to five days later by electro-fishing and seining in a similar manner and the marked to unmarked ratio noted. From past field experience, we believe that Peterson mark-recapture estimates could be derived by including fish caught by both electroshocking and seining. Population estimates were then computed using Seber's (1973) equation for the simple Petersen estimate

$$\hat{N} = \frac{(n_1 n_2)}{m_2}$$

Where: $\hat{N}$ = population estimate
n_1 = number marked
n_2 = number recaptured
m_2 = number of marks found in n_2 .

All salmonids sampled were separated into four categories: coho salmon, 0-age trout, steelhead, and cutthroat trout. Zero age trout are those less than 70 millimeters (mm); we have found this designation necessary because of the difficulties in separating small steelhead from small cutthroat in the field. Fish lengths were measured to the nearest mm fork length and a subsample was weighed to the nearest one-tenth gram for calculations of biomass and condition factor.

Some physical habitat parameters were measured by establishing transects and delineating different habitat types: pool, glide, or riffle. Rebar stakes were placed in the midchannel of the stream at the boundaries between habitat types and at the center of each habitat. The percent of each habitat type was then calculated by summing the areas for each and dividing by the total area. A subjective estimate of the type of substrate, amount and type of bank cover, percent overhead canopy, and instream cover was also recorded. Water temperature, dissolved oxygen and discharge was measured for each study section at a transect which formed the best hydraulic control.

The negative effects on salmonid production resulting from fine sediment in the spawning substrate has been documented by Koski (1966 and 1972), Bjornn (1968), Cederholm, et al (1981), and Iwamoto, et al (1978). Freeze core samples were collected in the Pilchuck River to assess relative changes in percent fine sediments. All samples were collected in riffle areas, which appeared to be suitable spawning sites. The size of sediments reported to be harmful to salmonids ranges from less than 0.85 mm (Cederholm, et al, 1981) to less than 3.33 mm (Koski, 1972). Sediments less then 1.00 mm were considered fines in this study. A total of 9 sieves, ranging from 50 mm to .106 mm, were used on samples prior to August, 1980. Samples taken after August, 1980, were processed with 12 sieves distributed within the same size range.

The Pilchuck River was sampled for biomass data in August, 1979, and in July, 1980. Four sites were used in 1979 (Figure 2); an upstream control (river mile 4.4), and upper and lower test section in the original river channel (river mile 3.9 and 3.3 respectively) and a downstream control (river mile 2.0). In 1980, the upstream control was moved upstream to river mile 4.8 in an attempt to improve mark and recapture estimates. The boundary of the 1979 upstream control traversed a large pool making it impossible to contain the fish in that site. The new site had convenient riffle areas at both established boundaries providing natural barriers. The upper test section in the original river channel at river mile 3.9 was not continued because of similar boundary problems. Two sites were also established in the new channel at river mile 3.3 and 3.0. The location of the downstream controm remained the same during each year of the study.

Freeze core samples were collected once in 1979, twice in 1980, and once more in 1981. Sampling in the old channel (river mile 3.3 and 3.0) was discontinued after July, 1980, because of the filling of the channel by the construction of a new highway. Two-way analysis of variance (ANOVA) was used to test for differences in mean percent fines at four sites (river mile 4.8, 3.3, 3.0 and 2.0) and three dates (July 1980, October, 1980, and August, 1981).

Childs Creek was sampled for biomass data three times in 1978 (June, July and September), three times in 1979 (March, June and October), and twice in 1980 (January and July). It should be noted that only two sites were used in the initial 1978 assessment (Figure 3). A downstream control (an area previously modified by rip-rap) was included in subsequent samples but was not utilized in this analysis because of the possible effects resulting from a prior modification.

Clear Creek was sampled once in 1979 and twice in 1980 (Figure 4). However, reduced funding and changes in program emphasis will no allow a post-construction assessment of this project. Therefore, population and biomass estimates are presented for informational purposes.

RESULTS

Pilchuck River

Population estimates and biomass data collected prior to channel modification in September, 1979 and July, 1980, are presented in Tables 1 and 2. Coho and 0 age trout population levels increased in 1980 over 1979 levels while steelhead decreased in all sections. Population estimates for all salmonids combined showed almost a three-fold increase in all sections in 1980 with

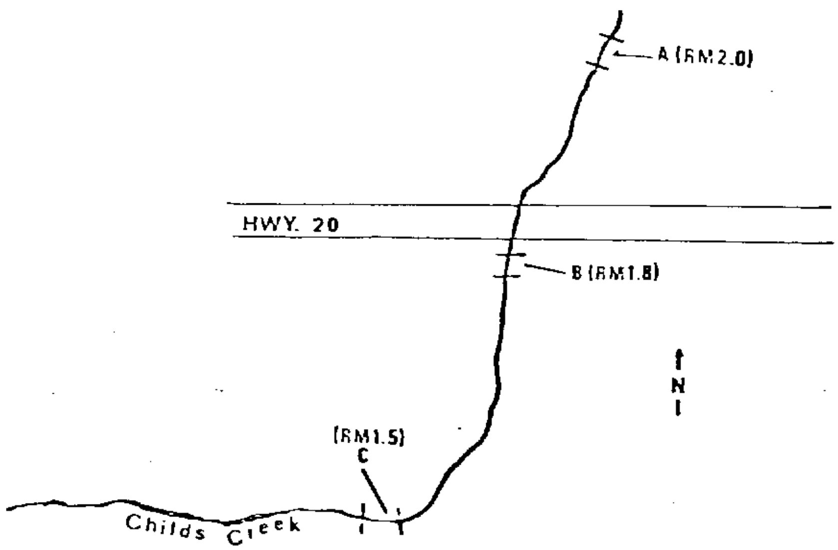

FIGURE 3. Study sites used in Childs Creek from July of 1978 to August of 1980: (A) Upstream control at river mile 2.0. (B) Channelized section of stream (test site) at river mile 1.8. (G) Previously rip-rap area at river mile 1.5.

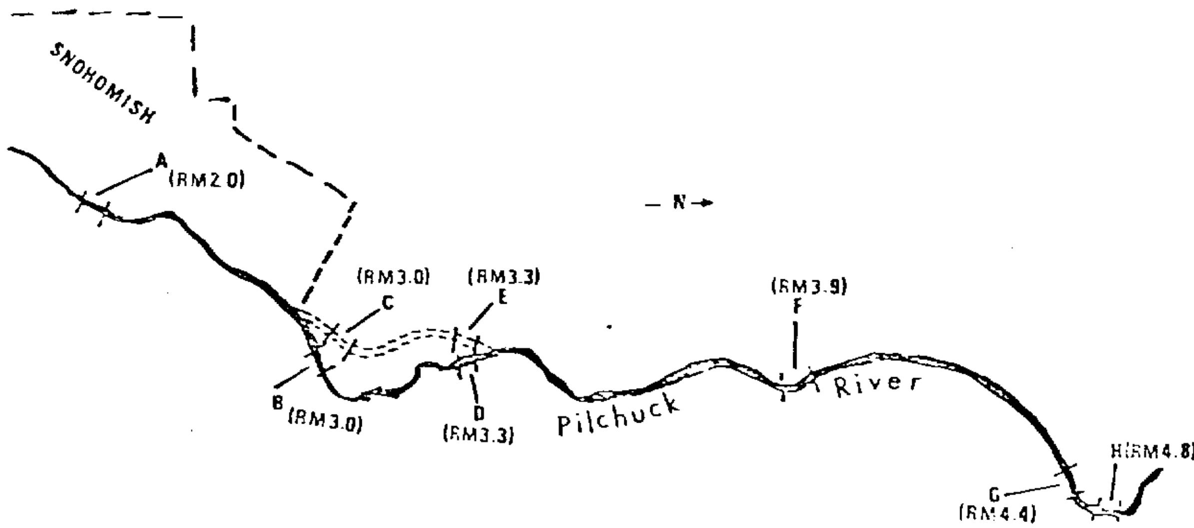

FIGURE 2. Study sites used in the Pilchuck River: (A) Downstream control used throughout the study from September 1979 to August of 1981 (river mile 2.0). (B) Lower old channel used in 1980 (river mile 3.0). (C) Lower new channel used in 1980 and 1981 (river mile 3.0). (D) Upper old channel used in 1979 and 1980 (river mile 3.3). (E) Upper new channel used in 1980 and 1981 (river mile 3.3). (F) An impacted area only sampled in 1979 (river mile 3.9). (G) Lower upstream control used in 1979 (river mile 4.4). (H) Upper upstream control used in 1980 and 1981 (river mile 4.8).

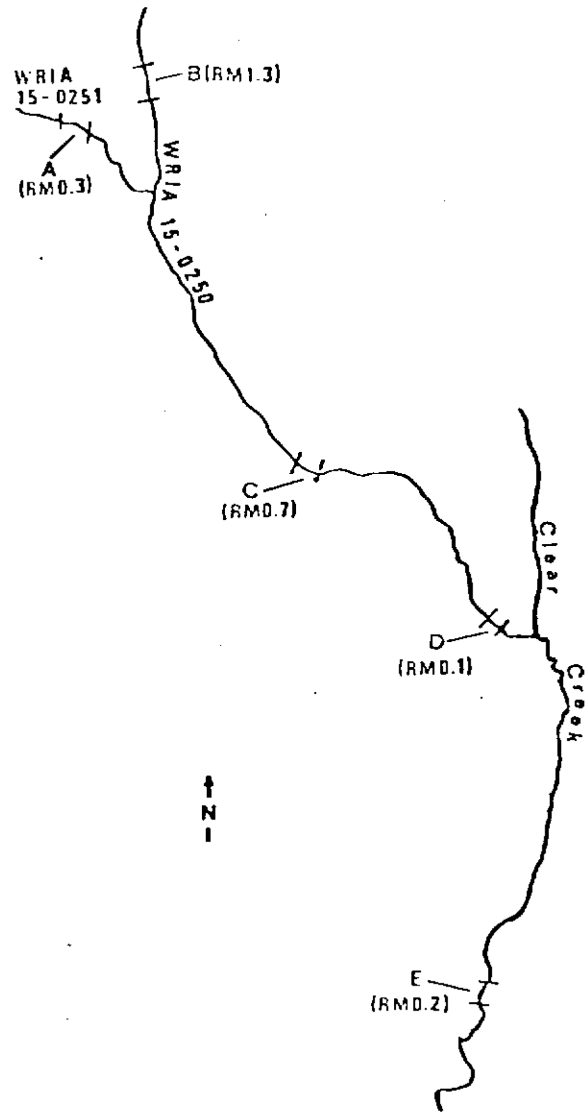

FIGURE 4. Study sites used in the Clear Creek watershed from October 1979 to July 1980 (numbers on streams are Washington State Water Resource Inventory area number): (A) Area of proposed channel change, river mile 0.3. (B) Upstream control at river mile 1.3. (C) Downstream control at river mile 0.7. (D) Lower downstream control at river mile 0.2. (E) Clear Creek control at river mile 0.2.

Table 1. Population estimates and 95% confidence intervals (CI) of salmonids captured by electrofishing and beach seining in study sections in the Pilchuck River.

POPULATION ESTIMATES (±CI)

Date	Location	River Mile	Coho	O+Trout	Steelhead	Cutthroat	All Salmonids
Sept. 6-17, 1979	Upstream Control	4.4	21(31)	51(70)	69(94)	3(7)	143(104)
	Old Upper Channel	3.9	3(6)	17(26)	96(129)	6(11)	124(91)
	Old Lower Channel	3.3	15(14)	105(60)	430(178)	3(6)	590(230)
	Downstream Control	2.0	9(8)	11(9)	337(99)	8(7)	367(103)
July 3-15, 1980	Upstream Control	4.8	89(42)	256(88)	44(39)	4(5)	392(107)
	Old Upper Channel	3.3	428(104	1859(372)	48(23)	5(7)	2520(468)
	New Upper Channel	3.3	501(182	249(77)	164(150)	0	877(209)
	Old Lower Channel	3.0	459(116)	516(101)	103(42)	5(6)	1094(161)
	New Lower Channel	3.0	1276(387	147(112)	31(18)	13(11)	1498(406)
	Downstream Control	2.0	47(37)	257(138)	22(21)	3(6)	362(188)

Table 2. Biomass (gram/meter^2) figures for samonids captured by electrofishing and beach seining in study sections in the Pilchuck River.

BIOMASS (g/m2)

Date	Location	River Mile	Coho	0+Trout	Steelhead	Cutthroat	All Salmonids
Sept. 6-17, 1979	Upstream Control	4.4	.18	.19	.69	.09	1.10
	Old Upper Channel	3.9	.08	.33	3.73	.45	4.72
	Old Lower Channel	3.3	.12	.43	7.37	.02	8.60
	Downstream Control	2.0	.12	.05	7.31	.19	7.66
July 3-15, 1980	Upstream Control	4.8	.22	.09	.59	.08	.99
	Old Upper Channel	3.3	1.20	.90	.67	.14	3.18
	New Upper Channel	3.3	2.72	.24	3.47	.03	6.46
	Old Lower Channel	3.0	2.78	.37	1.50	0	4.64
	New Lower Channel	3.0	4.36	.09	.85	.38	5.68
	Downstream Control	2.0	.10	.27	.45	.06	.88

the exception of the downstream control which decreased slightly. Biomass figures do not reflect the same increases in 1980 over 1979 except for coho. No post-construction population or biomass estimates were collected due to funding reductions previously cited.

The quantity of gravel material less than 1.00 mm, expressed as mean percentage of total volume, exhibited considerable variation from 1979 to 1981 (Figure 5). The largest change occurred in the lower new channel where 53% fines were observed after construction (Table 3). However, by August, 1981, the amount of fines had dropped to 8%. The upper new channel and downstream control sites also declined from high percentage fines to much lower percentages one year later.

Samples from the upstream control were considerably lower in percent fines compared to the two test sites in the new channel, as well as the downstream control during July, 1980. In October, 1980, the lower new channel decreased significantly but still remained much higher than the other three sites. The August, 1981 samples show that all sites decreased in percent fines relative to the previous sampling period with the exception of the downstream control which increased slightly. An ANOVA test (α = 0.01) indicates that there are significant differences in mean percent fines between the upstream control, the two new channel test sites, and the downstream control. The test also reveals significant differences in percent fines between the three sample dates of July, 1980, October, 1980 and August, 1981.

Childs Creek

Population estimates and biomass data from Childs Creek were collected from 1978-1980 (Table 4-5). In July, 1978, just prior to channelization, the upstream control and test site (channelized section) exhibited large differences in salmonid population estimates. A preponderance of coho and 0 age trout were found in the test site compared to the upstream control, while a relatively large number of cutthroat were found in the upper control and not in the test site. The biomass figures indicate that these cutthroat were large in comparison to the other salmonids. Immediately after channelization (August, 1978), the population levels in the test site did not appear to change significantly although an almost two-fold increase was observed for coho in the upstream control. Zero-age trout increased slightly while numbers of cutthroat decreased in the upstream control. In October, 1978, the number of salmonids declined significantly in both sections although 0-age trout exhibited a much greater decline in the test section then in the upstream control. Salmonid biomass estimates also reflect a substantial decrease.

Few salmonids were observed in either section in March, 1979. By late July of 1979, the upstream control exhibited population levels comparable to early August of 1978. However, the salmonid population in the test section decrased by almost one-half compared to the previous year. Salmonid biomass increased from 7.00 grams/meter (g/m) to 7.07 g/m in the test section and from 5.60 g/m to 9.87 g/m in the upstream control. Sampling in the fall of 1979 revealed a decline in population levels similar to that found in 1978. Zero-age trout population levels in August 1980, were within the range of values present in 1978 and 1979.

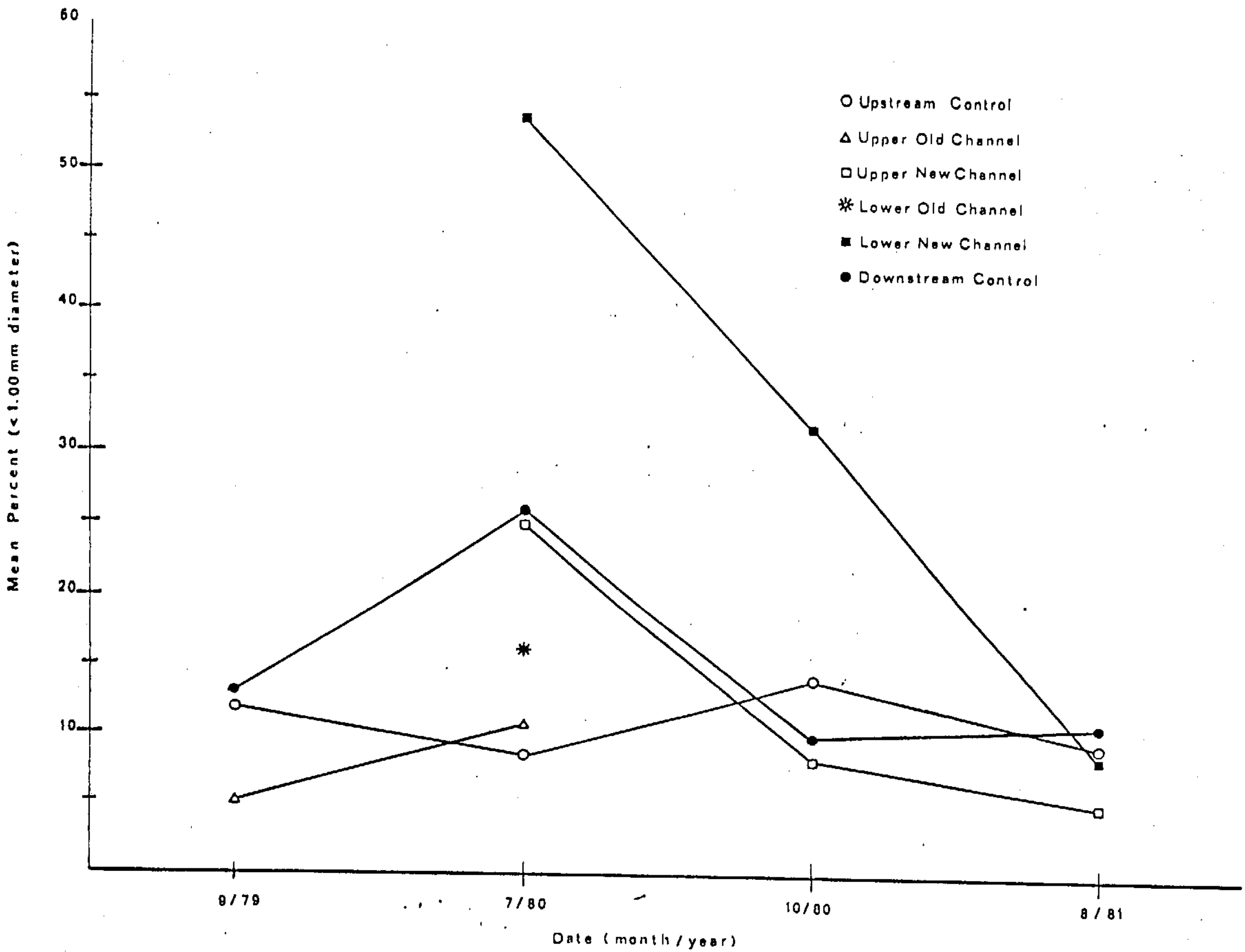

FIGURE 5. Mean percent fines (gravel size 1.00mm diameter) found in freeze core samples taken from 6 sites on the Pilchuck River from September 1979 to August of 1981.

Table 3. Four sites used for gravel sample comparison from the Pilchuck River, 1980-81.

Date	Location	River Mile	Mean % fines (<1.00 mm diameter)	Standard Deviation
7-15-80	Upstream Control	4.8	8	6.7
7-8-80	Upper New Channel	3.3	25	26.5
7-9-80	Lower New Channel	3.0	53	30.8
7-2-80	Downstream Control	2.0	26	26.0
10-8-80	Upstream Control	4.8	14	7.0
10-8-80	Upper New Channel	3.3	8	4.7
10-8-80	Lower New Channel	3.0	32	16.1
10-8-80	Downstream Control	2.0	10	3.4
8-7-81	Upstream Control	4.8	9	5.7
8-7-81	Upper New Channel	3.3	5	3.5
8-7-81	Lower New Channel	3.0	8	4.6
8-7-81	Downstream Control	2.0	11	3.7

Table 4. Population estimates and 95% confidence intervals (CI) of salmonids captured by electrofishing in upstream control (RM. 2.0), test (RM. 1.8), and downstream control (RM. 1.5) sections of Childs Creek, 1978-1980.

POPULATION ESTIMATES (± CI)

Date	River Mile	Coho	0+Trout	Steelhead	Cutthroat	All Salmonids
July 13, 1978	2.0	221(44)	190(35)	0	64(127)	457(66)
	1.8	835(123)	377(80)	0	10	1224(148)
August	2.0	441(43)	224(108	0	20(13)	626(71)
10-11, 1978	1.8	816(95)	412(48)	0	25(120)	1240(105)
	1.5	423(17)	80(5)	0	0	503(17)
Oct. 11, 1978	2.0	73(13)	167(119)	0	13(2)	219(47)
	1.8	2	7	1	0	10
	1	1.5	14(2)	2	0	17(1)
March	2.0	0	5(3)	4	5(3)	13(2)
19-20, 1979	1.8	1	2	2	2	8
	1	0	8(10)	8(10)	6(1)	22(7)
July	2.0	474(30)	274(94)	5(2)	38(7)	743(58)
25-26, 1979	1.8	167(15)	173(24)	0	1	635(22)
	1.5	792(154)	80(33)	8(1)	33(1)	864(119)
Oct. 31-	2.0	72(7)	191(19)	2	22(1)	285(18)
Nov. 1, 1979	1.8	34(11)	11(3)	0	43(7)	100(24)
	1.5	206(3)	24(1)	12(5)	38	274(3)
January	2.0	0	42(6)	1	13(6)	56(8)
24-25, 1980	1.8	0	17(1)	1	12(2)	30(2)
	1.5	0	37(1)	1	24(1)	62(2)
August	2.0	22(2)	420(11)	0	17(1)	458(11)
6-7, 1980	1.8	10	309(44)	0	27(7)	335(44)
	1.5	6	307(4)	0	24(1)	239(4)

BIOMASS

Table 5. Biomass (grams/meter^2) figures for salmonids captured by electrofishing in upstream control (RM 2.0), test (RM.1.8), and downstream control (RM.1.5) sections of Childs Creek, 1978-80

Date	River Mile	Coho	O+Trout	Steelhead	Cutthroat	All Salmonids
July 13, 1978	2.0	1.80	.70	0	4.3	6.80
	1.8	4.00	1.0	0	1.7	6.60
Aug.10-11, 1978	2.0	3.9	.80	0	.90	5.60
	1.8	3.7	1.30	0	2.00	7.00
	1.5	2.4	.40	0	0	2.70
Oct. 11, 1978	2.0	1.0	1.20	.20	.90	3.20
	1.8	0	.10	0	0	.10
	1.5	0	.20	.10	0	.30
March 19-20,1979	2.0	0	.05	.15	.30	.50
	1.8	.02	.02	.04	.04	.12
	1.5	0	.06	.29	.20	.55
July 25-26, 1979	2.0	4.56	2.35	.63	2.36	9.87
	1.8	5.52	1.50	0	.05	7.07
	1.5	8.15	1.4	.67	2.78	13.00
Jan. 24-25, 1980	2.0	0	.27	.09	.42	.78
	1.8	0	.15	.04	.44	.63
	1.5	0	.41	.12	.65	1.18
Oct. 31- Nov. 1, 1980	2.0	1.02	2.58	.28	.97	4.58
	1.8	.28	.10	0	.60	.98
	1.5	3.98	.43	1.25	1.77	7.44
Aug. 6-7, 1980	2.0	.28	3.63	0	.82	4.74
	1.8	.18	3.40	0	1.25	4.84
	1.5	.13	2.65	.01	1.18	3.97

Trout abundance in the upstream control was again higher than that found in the test section. Coho abundance in 1980 was much less than 1978 or 1979 levels in both control and test sections.

Clear Creek

Initial sampling of Clear Creek took place in October, 1979. As expected, small numbers of salmonids were present in the fall with coho being the most numerous (Table 6 - 7). Sampling in January, 1980 provided evidence of another decrease in the total number of salmonids present. By July, 1980, abundance of all salmonids combined had increased to summer rearing densities.

DISCUSSION

Pilchuck River

No population of biomass data was collected after rerouting of the Pilchuck River and, therefore, no assessment of possible impacts on salmonid rearing density was possible. However, information provided by gravel samples taken over a three-year period provide data from which some conclusions can be drawn.

Studies of the Clearwater River on Washington's Olympic Peninsula by the Fisheries Research Institute (FRI) of the University of Washington (Cederholm et al, 1980), have shown decreased survival of coho salmon eggs under conditions of high streambed sedimentation. These studies indicated consistently lower survival when percent fines (fines were defined as sediments less than 0.85 mm in diameter) approached 20% of the bed composition.

Although normal levels of fines in Pilchuck River sediments were not defined, it is obvious that the substrate in the new channel contained a very high percentage of fine sediments (25-53%). The downstream control, which is less than 1.0 mile below the construction area, was apparently contaminated with sediments from the construction project (26% fines). Shortly after complete diversion of the entire river into the new channel, but before high winter flows, a substantial reduction in percent fines occurred, particularly at the upper test site and downstream control. Percent fines in the lower test site also declined, but remained at high levels.

One year after diversion of the river, the streambed of the new channel appeared to have returned to normal levels of fine sediments. Winter high flows probably moved gravel into the channel from upstream areas while washing fines downstream. Field observations indicate that approximately 45 centimeters of gravel had been deposited in some areas of the channel. The downstream control contained the highest percent fines one year after construction, although observed values at this site may be within a range normally expected.

Table 6. Population estimates of salmonids captured by electrofishing in study sections in the Clear Creek drainage (numbers under location heading refer to Washington State Water Resource Inventory Area numbers).

POPULATION ESTIMATES (± CI)

Date	Location	River Mile	Coho	0+Trout	Steelhead	Cutthroat	All Salmonids
Oct. 29, 1979	15-0250	1.3	46(6)	9(22)	5(8)	13(6)	74(13)
	"	.7	29(2)	13(2)	7	8(1)	55(2)
	"	.1	24(4)	16(5)	11(26)	6(2)	58(11)
Jan.29-30,1980	15-0250	1.3	12(2)	4(7)	5	4	24(2)
	"	.7	4	1	4	5	14
	"	.1	1	2	2(2)	2(2)	10(13)
July 22, 1980	15-0250	1.3	102(23)	51(9)	1	6	158(22)
	"	.7	80(5)	41(4)	3	4	127(6)
	"	.1	113(30)	71(53)	5	7	196(50)
	15-0251	.3	86(4)	78(19)		38	195(9)
	15-0249	.2	72(15)	48(31)	3	12(8)	132(25)

While the gravel composition of the new channel appeared to return to normal levels one year after diversion, the character of the stream was radically different than the original stream. The new channel is almost entirely glide habitat with steep UNVEGITATED banks, where as the old stream contained alternating pools and riffles bordered by typical riparian habitat. A number of streamside enhancement devices (pools, imbedded logs, and boulders) were incorporated into the new channel. Observations a year later showed that the pools had filled in with gravel and only a few large boulders were still visible.

Childs Creek

Salmonid rearing densities in Childs Creek appeared to exhibit some response to channelization of the streambed. However, the response was much less obvious than expected. Winter rearing capacity may have actually been impacted more than summer rearing. Overhanging banks and instream cover were removed during channelization. Bustard and Narver (1975) found these structures to be essential in the winter ecology of juvenile steelhead and coho. The summer rearing capacity of this stream did appear to recover two years after channelization. Rearing densities for all species were comparable in the control and test site two years after construction although the pool:riffle character of the stream was again altered.

Variability associated with our salmonid population and biomass estimates in Childs Creek is probably high. A number of factors are involved in assessing changes in salmonid stream rearing densities and it was not possible to isolate those responsible for the changes observed. No assessment was made of impacts on spawning success resulting from this project. Therefore, definitive evaluation of the impacts resulting from this project was not possible.

Table 7. Biomass (grams/meter$_2$) figures for salmonids captured by electrofishing in the Clear Creek drainage.

BIOMASS (g/m2)

Date	Location	River Mile	Coho	O+Trout	Steelhead	Cutthroat	All Salmonids
Oct. 29, 1979	15-0250	1.3	3.20	.32	1.48	3.41	8.35
	"	.7	.94	.20	1.70	1.06	3.90
	"	.1	.94	.45	2.54	1.38	5.31
Jan. 29-30,1980	15-0250	1.3	.53	.09	.72	1.59	2.93
	"	.7	.14	.02	.51	.50	1.17
	"	.1	.09	.04	.57	.09	.79
July 22, 1980	15-0250	1.3	3.40	.84	.46	2.20	6.90
	"	.7	1.80	.29	.25	.20	2.98
	"	.1	2.37	.54	-	1.24	4.16
	15-0251	.3	1.57	.79	0	4.16	6.52
	15-0249	.2	.72	.14	.07	.81	1.75

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